IN THE DRAWINGS:

Please replace FIG. 1A with the attached replacement drawing sheet.

REMARKS

Claims 1-28 and 34 are pending in the application. Claims 1-28 and 34 have been examined and are rejected. Claims 1, 5, 12, 13, 16, 17, 19, 23, 25, 27 and 34 have been amended to more clearly define the invention. Reconsideration and allowance of the claims are respectfully requested.

THE SPECFICATION

The specification has been amended to correct typographical errors noted in the Office Action. Applicant thanks the Examiner for the careful reading of the specification and claims.

THE DRAWINGS

The drawings are objected to because FIG. 1A does not have microphone 110a. Applicant's copy of the present application shows microphone 110a just above the steering wheel in FIG. 1A. To avoid ambiguity, Applicant is submitting a replacement drawing sheet for FIG. 1A with microphone 110a shown above the steering wheel.

THE CLAIMS

Election/Restrictions

Applicant elects to prosecute claims 1-28 and 34 in Group 1. Claims 29-33 and 35 in Group II have been withdrawn in response to the restriction requirement.

Claim Objections

Claims 23, 25 and 27 are objected to because the phrase "multiplier configured to multiple" is ambiguous. Each of these claims has been amended to recite "multiplier configured to multiply".

Rejection of Claims 1-12, 14-20, 22-25 and 28 Under 35 U.S.C. §103(a)

Claims 1-12, 14-20, 22-25 and 28 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Meyer *et al.* (1997 IEEE) in view of Pollak *et al.* (Eurospeech 1993). The rejection states that Meyer teaches the signal processor but not the first or

second signal detector of claim 1. The rejection indicates that Pollak teaches the first and second signal detectors of claim 1.

Meyer describes a multi-channel algorithm for speech enhancement. N microphone signals $x_0(t)$ through $x_{N-1}(t)$ are transformed with FFTs to obtain N signals $X_0(f)$ through $X_{N-1}(f)$, respectively, which are added together and scaled by 1/N to generate a signal $Y_b(f)$. Spectral subtraction is performed on low frequency components, and Wiener filtering is performed on high frequency components. The resultant low and high frequency components are then added and transformed with an IFFT to generate the output signal y(t).

Pollak describes a noise suppression system that uses one – maximally two – microphones. "One-channel spectral subtraction method is used for the suppression of the noise caused by the engine and by the vibrations of the car body. Two-channel adaptive noise canceller can be used for a radio noise because it is easier to get a noise reference signal without crosstalks in this case." Figure 1 shows the one-channel spectral subtraction method.

Claim 1 of the present invention, as amended, recites:

> "A signal processing system used in automobile to suppress noise from a speech signal comprising:
>
> a first signal detector configured to provide a first signal comprised of a desired component plus an undesired component, wherein the desired component includes speech;
>
> a second signal detector configured to provide a second signal comprised mostly of an undesired component; and
>
> a signal processor operatively coupled to the first and second signal detectors and configured to process the first and second signals based on a cancellation technique to remove correlated undesired component and further based on at least one noise suppression technique to remove uncorrelated undesired component and to provide an output signal having a substantial portion of the desired component and a large portion of the undesired component removed."

Applicant submits that claim 1 is patentable over Meyer in view of Pollak for at least the following reasons.

First, neither Meyer nor Pollak describe "a first signal comprised of a desired component plus an undesired component" and "a second signal comprised mostly

of an undesired component," as claim 1 recites. The rejection states that Pollak describes this feature on page 1, paragraph 2, lines 9-12. However, this section of Pollak states "two-channel adaptive noise canceller can be used for a radio noise because it is easier to get a noise reference signal without crosstalks in this case." This section does not describe what signals have been detected, what components are included in each signal, or how the reference signal is generated. This section does not explicitly describe or suggest the first and second signals having the components recited in claim 1.

Second, neither Meyer nor Pollak describe "a signal processor ... to process the first and second signals based on a cancellation technique to remove correlated undesired component and further based on at least one noise suppression technique to remove uncorrelated undesired component," as claim 1 recites. Meyer describes processing the low frequency components with spectral subtraction and processing the high frequency components with a Wiener filter. Each frequency component is thus processed with only either spectral subtraction or Wiener filtering, which is not able to effectively remove both correlated and uncorrelated undesired components. Similarly, Pollak shows a 1-channel spectral subtraction method, which is also not able to effectively remove both correlated and uncorrelated undesired components.

Third, neither Meyer nor Pollak describe using different types of processing, "a cancellation technique" and "at least one noise suppression technique", to remove correlated and uncorrelated undesired components.

For at least the above reasons, Applicant submits that claim 1 of the present invention is patentable over Meyer in view of Pollak.

Claims 2-12 and 14-18 are dependent on claim 1 and are patentable over Meyer in view of Pollak for at least the reasons noted above for claim 1. These dependent claims may recite additional features not described by Meyer or Pollak.

For claim 3, neither Meyer nor Pollak describe "the second signal detector is a sensor configured to detect automobile vibration." Pollak states that "one-channel spectral subtraction method is used for the suppression of the noise caused by the engine and by the vibrations of the car body" (see page 1, paragraph 2, lines 9-12). This one-channel method is shown in Figure 1 and has only one input signal x[n], which includes both speech and noise. Pollak does not use a sensor to detect automobile vibration.

For claim 4, neither Meyer nor Pollak describe "the second signal detector is a sensor configured to detect mostly noise." Pollak states that "two-channel adaptive noise canceller can be used for a radio noise because it is easier to get a noise reference signal without crosstalks" (see page 1, paragraph 2, lines 9-12). However, Pollak does not describe how this noise reference signal is generated, for example, whether by processing a signal containing speech and noise or by a sensor that detects mostly noise.

For claim 5, Meyer does not describe "an adaptive canceller configured to process the first and second signals in accordance with a set of coefficients, to provide an intermediate signal ..., and to adjust the set of coefficients using the intermediate signal." The Wiener filter of Meyer is not adaptive. Meyer derives the coefficients for the Wiener filter based solely on the input signals $X_0(f)$ through $X_{N-1}(f)$ and $Y_b(f)$. Meyer does not use the output signal from the Wiener filter to generate the filter coefficients.

For claims 7 and 8, Meyer does not describe an adaptive canceller, as noted above for claim 5. Hence, Meyer does not describe implementing the adaptive canceller in the time domain (claim 7) or the frequency domain (claim 8). The rejection states that filtering in the time-domain and frequency-domain are well known and "either choice should work equally well". However, as noted in paragraph [145] of the present application, "the frequency-domain adaptive filter may provide certain advantageous over a time-domain adaptive filter including (1) reduced amount of computation in the frequency domain, (2) more accurate estimate of the gradient due to use of an entire block of data, (3) more rapid convergence by using a normalized step size for each frequency bin, and possibly other benefits." Thus, there are certain advantages for one choice over another depending on the implementation of the signal processing.

For claim 10, neither Meyer nor Pollak describe "a noise suppression unit configured to receive and process the first and second signals to suppress the undesired component in the first signal." Meyer shows a one-channel spectral subtraction block that receives one input $Y_b(f)$. Similarly, Pollak shows a one-channel spectral subtraction block that receives one input X(k).

For claims 16 and 17, neither Meyer nor Pollak describe the use of two noise suppression techniques to reduce the undesired component.

Independent claim 19 has been amended to recite the features noted above for claim 1 and should be patentable over Meyer in view of Pollak for at least the reasons

noted above for claim 1. Neither Meyer nor Pollak describe the use of both (1) an adaptive canceller to remove correlated undesired component and (2) a noise suppression unit to suppress uncorrelated undesired component. Claims 20, 22-25 and 28 are dependent on claim 19 and are patentable for at least the reasons noted for claim 19.

Accordingly, the §103(a) rejection of claims 1-12, 14-20, 22-25 and 28 should be withdrawn.

Rejection of Claims 13, 21, 26-27 and 34 Under 35 U.S.C. §103(a)

Claim 13 stands rejected under 35 U.S.C. §103(a) as being unpatentable over Meyer in view of Pollak, as applied to claim 1, and further in view of Boll (1979 IEEE). Claim 13 is dependent on claim 1, which Applicant submits is patentable over Meyer in view of Pollak for the reasons noted above. Hence, the combination of Meyer and Pollak is an insufficient basis for the §103(a) rejection of claim 13.

Claims 21, 26 and 27 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Meyer in view of Pollak, as applied to claim 19, and further in view of Boll. Claims 21, 26 and 27 are dependent on claim 19, which Applicant submits is patentable over Meyer in view of Pollak for the reasons noted above. Hence, the combination of Meyer and Pollak is an insufficient basis for the §103(a) rejection of claims 21, 26 and 27. Furthermore, for claim 21, Boll does not describe "the adaptive canceller is configured to adaptively cancel the correlated portion of the undesired component based on a non-linear transfer function." Rather, Boll describes half-wave rectification in Fig. 1, but not in the context of an adaptive canceller.

Claim 34 stands rejected under 35 U.S.C. §103(a) as being unpatentable over Meyer in view of Boll. Applicant submits that the combination of Meyer and Boll does not describe all of the elements of claim 34. In particular, Meyer and Boll do not describe "removing a portion of the undesired component in the first signal that is correlated with the undesired component in the second signal based on adaptive cancellation" and "removing an additional portion of the undesired component in the first signal that is uncorrelated with the undesired component in the second signal based on spectrum modification." Claim 34 utilizes different processing techniques to remove both correlated and uncorrelated undesired components.

Accordingly, the §103(a) rejection of claims 13, 21, 26-27 and 34 should be withdrawn.

CONCLUSION

Applicant believes all claims now pending in this application are in condition for allowance. The issuance of a formal Notice of Allowance at an early date is respectfully requested.

If the Examiner believes a telephone conference would expedite prosecution of this application, please telephone the undersigned at (650) 289-0600.

Respectfully submitted,

Truong T. Dinh
Reg. No. 40,993